North Dakota's SO2
PSD Air Quality Modeling Report

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This is a final report which sets forth the results of modeling conducted by the State of North Dakota pursuant to the MOU of February 24, 2004 between the State and the United States Environmental Protection Agency.

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1.0 Introduction

On February 24, 2004, the state of North Dakota (State) and the United States Environmental Protection Agency (EPA) entered into a memorandum of understanding (MOU) "to identify a process for resolving several issues relating to the modeling protocol for the State's Prevention of Significant Deterioration (PSD) program."[1]

The State has an EPA-approved State Implementation Plan (SIP) under the Clean Air Act (CAA). It has administered the PSD provisions of its SIP since Congress enacted the PSD amendments to the CAA in 1977.[2] In May, 2002, and in June, 2003, the State held a PSD periodic review hearing under 40 C.F.R. § 51.166(a)(4) to address several issues, including refining the modeling analysis for PSD increment review, determining the role of monitoring data in PSD compliance, reviewing the adequacy of the State's SIP, and determining whether the PSD increments were being violated. On September 8, 2003, State Health Officer Terry L. Dwelle, M.D. issued a final order determining that there are currently no PSD Class I sulfur dioxide increment violations occurring in North Dakota or Eastern Montana, and that the State's SIP is adequate to protect against air quality deterioration.[3] The State and EPA later agreed to a process in the MOU for resolving several issues relating to the PSD modeling that had arisen in the State's periodic review hearings.

Under the MOU, the State agreed to conduct "draft alternative modeling based on the issues on which the State and EPA agree."[4] After much discussion, the State and EPA reached agreement on a modeling protocol on April 28, 2004. On May 5, 2004, the State forwarded the finalized modeling protocol to EPA.[5] Shortly thereafter, the state initiated modeling activities following the EPA-approved protocol. This report summarizes that modeling.

Results of the modeling effort demonstrate that the State is in compliance with the PSD Class I 24-hour and 3-hour SO2 increments. Under the terms of the MOU, neither the State nor EPA are bound by the results of this modeling.[6]

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[1] February 24, 2004, ND-USEPA MOU, p.1. A copy of the February 24, 2004, MOU is attached as Addendum "A".

[2] See 40 C.F.R. Part 52, §§1820-1836. The PSD provisions of the CAA are CAA Part C, Subpart I, §§ 160-169, 42 U.S.C. §§ 7470-7479. As noted in Addendum "G", part 2.2, and Addendum "H", part 2.0 through 2.4.2, North Dakota was one of the first states, if not the first, to implement a PSD program and do PSD air quality modeling.

[3] Copies of August 8, 2002 and September 8, 2003, Orders of North Dakota State Health Officer Terry L. Dwelle, M.D., are attached to this report as Addendum "E".

[4] February 24, 2004, ND-USEPA MOU, p.1, Recitals ¶ 3.

[5] A copy of the agreed upon April 30, 2004 modeling protocol and May 5, 2004 cover letter to William Wehrem are attached in the Addendum "B".

[6] February 24, 2004, ND-USEPA MOU, p.1, Recitals ¶ 3.

In addition, the results of the SO2 modeling summarized in this report that acknowledge applicable federal land manager (FLM) certifications, demonstrate compliance with all short term SO2 increments, with a highest second-high 24-hour SO2 modeled deterioration of 4.6 µg/m3 using the 2000-2001 SO2 emissions inventory and 4.0 µg/m3 using the 2002-2003 SO2 emissions inventory.

2.0 Background on the CAA and PSD Requirements

The CAA amendments of 1970 established the current structure of the CAA.[7] The CAA is "a comprehensive national program that ma[kes] the States and the Federal Government partners in the struggle against air pollution."[8] At the same time, the CAA recognizes that "air pollution prevention . . . and air pollution control at its source is the primary responsibility of States and local governments."[9]

The CAA requires each State to adopt and submit for the EPA's approval a SIP that provides for the attainment and maintenance of the National Ambient Air Quality Standards (NAAQS).[10] The NAAQS are scientifically-established standards that protect public health (primary) and welfare (secondary). North Dakota is one of only eleven states currently in compliance with all of the NAAQS,[11] and is one of only six states that has never had a violation of any of the NAAQS since the CAA was enacted in 1970.[12]

In addition to the NAAQS, Congress passed an amendment to the CAA in 1977 to protect air quality from significantly deteriorating in areas like North Dakota where the air quality is better than the NAAQS – the "Prevention of Significant Deterioration of Air Quality" program – a program that has come to be known by its acronym, "PSD". Areas of the country that meet the NAAQS for a given pollutant (attainment areas) or for which insufficient information exists to

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[7] A more detailed history of the CAA and its development is attached under Addendum "G".

[8] General Motors Corp. v. United States, 496 U.S. 530, 532 (1990).

[9] 42 U.S.C. § 7401(a)(3) (emphasis added); see also id. § 7407(a) ("Each State shall have the primary responsibility for assuring air quality within the entire geographic area comprising such State") (emphasis added). Thus, while the CAA assigns the EPA the responsibility for establishing national ambient air quality standards ("NAAQS") for certain pollutants, see id. § 7409, the Act assigns the States the responsibility for implementing them. See id. §§ 7407(a), 7410(a).

[10] See id. § 7410(a).

[11] EPA website, EPA Green Book, at http://www.epa.gov/oar/oaqps/greenbk/multipol.html. (ND is not listed - only non-compliant states and regions are listed.)

[12] EPA website, EPA Green Book, at http://www.epa.gov/oar/oaqps/greenbk/anay.html. (ND is not listed - only non-compliant states and regions that at sometime violated the NAAQS are listed.) A summary of North Dakota's current air quality in relation to the NAAQS is made in Addendum "F", "Monitored Air Quality in North Dakota: A Summary".

determine whether the NAAQS have been met (unclassifiable areas) are known as "clean air" areas.[13] Areas in states that comply with the NAAQS are divided into three general categories: (1) class I areas, which include certain national parks and wilderness areas; (2) class II areas, which are intended to accommodate "moderate" growth; and (3) class III areas, which are intended to accommodate "intensive major industrial growth."[14]

The CAA establishes maximum allowable increases (or increments) of certain pollutants in such clean air areas.[15] The CAA requires that each SIP contain emission limitations and such other provisions as may be necessary "to prevent significant deterioration of air quality" by tracking deterioration (increment consumption) in clean air areas, including a PSD permit program.[16]

The CAA reserved to each state a considerable amount of discretion and authority for managing allowable PSD "increments" of air quality deterioration. Some of the pertinent elements of state authority include the authority to:

- Designate[17] (and redesignate when appropriate)[18] the size and location of the various PSD air quality management regions or areas within its borders;

- Redesignate PSD air quality management regions from class II to class III, when a state determines that it wants to allow more deterioration in an air quality management region than allowed by Congress' original class II designation, or redesignate PSD air quality management regions from class II to class I, when a state determines that it wants to allow less deterioration in an air quality management region than allowed by Congress' original class II designation;[19]

- Consider major source preconstruction applications, make permitting decisions, and determine the best available control technology (BACT) for new major emitting facilities and existing facilities undergoing major modifications;[20]

- Establish the baseline concentration by monitoring ambient concentration levels, and by making adjustments to the monitored baseline ambient concentration levels with computer

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[13] Id. § 7407(d)(1)(A)(ii), (iii).

[14] See 42 U.S.C. §§ 7472, 7474(a); H.R. Rep. No. 95-294, at 152-153 (1977).

[15] Id. §§ 7473, 7475(d) (sulfur dioxide increments and alternative increments); see also 40 C.F.R. § 51.166(c).

[16] Id. §§ 7410(a)(2)(C), 7471.

[17] Clean Air Act §§ 107 & 161, 42 U.S.C. §§ 7407 & 7471.

[18] Clean Air Act § 164(a); 42 U.S.C. § 7474(a).

[19] Clean Air Act § 164(a); 42 U.S.C. § 7474(a).

[20] Clean Air Act § 169(1)-(3), 42 U.S.C. §7479(1)-(3).

modeling, after taking into account projected emissions from a source that had commenced construction but not begun operation by January 6, 1975, as well as actual emissions after the baseline date if a source can demonstrate that its operation after the baseline date is more representative of normal source operation than its operation preceding the baseline date;[21] and

- Participate in proceedings that make adjustments in application of the Class I increments in mandatory class I areas based on air quality related values after scientific studies are done, public hearings are held, and determinations are made by the state's governor and the federal land manager, or, if they cannot agree, by the president.[22]

Congress made national wilderness areas larger than 5,000 acres, and national parks larger than 6,000 acres, mandatory class I areas that cannot be redesignated.[23] Since the Lostwood Wilderness Area (LWA – a national wilderness area larger than 5,000 acres) and the Theodore Roosevelt National Park (TRNP – a national park larger than 6,000 acres) fit into these two categories, they are mandatory class I areas that cannot be redesignated.[24]

CAA § 163 establishes "the maximum allowable increase in concentrations of sulfur dioxide … over the baseline concentration" (commonly referred to as the Class I increments for SO2) as follows for these mandatory class I areas:

- Annual mean, 2 micrograms per cubic meter (0.77 ppb);
- 24-hour maximum, 5 micrograms per cubic meter (1.92 ppb); and
- 3-hour maximum, 25 micrograms per cubic meter (9.62 ppb).[25]

The CAA also allows the 24-hour and 3-hour increments each to be exceeded once per year.[26]

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[21] N.D. Admin. Code § 33-15-15-01(a)(1); 40 C.F.R. § 51.166(b)(21)(ii); 40 C.F.R. § 52.21(b)(21)(ii); 45 Fed. Reg. 52675, 52714 (August 7, 1980); *Alabama Power Co. v. Costle*, 636 F.2d 323, 372, 381, 387 (D.C. Cir. 1980); EPA's *Prevention of Significant Deterioration Workshop Manual* (October 1980).

[22] Clean Air Act § 165(d)(2)(C) & (D), 42 U.S.C. § 7475(d)(2)(C) & (D).

[23] Clean Air Act § 162(a)(2) & (4), 42 U.S.C. § 7472(a)(2) & (4).

[24] Id. Technically, on August 7, 1977, TRNP was a national memorial park larger than 5,000 acres covered by Clean Air Act § 162(a)(3), 42 U.S.C. § 7472(a)(3), rather than a national park. On November 10, 1978, the park was given national park status when President Carter signed Public Law 95-625 that changed the memorial park status to Theodore Roosevelt National Park. See TRNP website at http://www.nps.gov/thro/tr_parkhist.htm.

[25] Clean Air Act § 163(b)(1), 42 U.S.C. § 7473(b)(1).

[26] Clean Air Act § 163(a), 42 U.S.C. § 7473(a).

The CAA also provides for the following alternative maximum allowable increases over the baseline concentration of SO2 after certification by the federal land manager that the increased emissions from a facility will have no adverse impact on air quality-related values:[27]

- Annual mean, 20 micrograms per cubic meter (7.7 ppb);
- 24-hour maximum, 91 micrograms per cubic meter (35 ppb); and
- 3-hour maximum, 325 micrograms per cubic meter (125 ppb).[28]

Unlike other increments, these alternative increments cannot be exceeded even once per year.[29] These alternative SO2 Class I increments are all exactly one-fourth (1/4) of the annual, 24-hour, and 3-hour NAAQS for SO2.[30]

Compliance with the PSD increments is evaluated under one of two circumstances: when a major emitting facility is constructed or modified;[31] or when a state determines that a PSD periodic review is necessary to determine the consumption status of the PSD increment.[32]

The State completed a periodic review to determine North Dakota's status in complying with the PSD SO2 increment on September 8, 2003. The State and EPA entered into an MOU to establish a process for resolving several issues relating to the PSD modeling protocol that arose out of the periodic review.

3.0 Description of Modeling under MOU

The State began modeling under the MOU in May, 2004. By late June, the State had nearly completed draft modeling that tentatively showed no more than one exceedance of any of the relevant PSD Class I sulfur dioxide increments at any model receptor. In late June, however, a

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[27] Clean Air Act § 165(d)(2)(C)(iii), 42 U.S.C. § 7475(d)(2)(C)(iii).

[28] Clean Air Act § 165(d)(2)(C)(iv), 42 U.S.C. § 7475(d)(2)(C)(iv).

[29] Clean Air Act § 163(a), 42 U.S.C. § 7473(a).

[30] Still other alternative increments apply if the federal land manager does not certify there is no adverse impact, the state's governor grants a variance anyway, and the federal land manager concurs or does not concur, then the alternative 24-hour and 3-hour increments at Clean Air Act § 165(d)(2)(D)(iii), 42 U.S.C. § 7475(d)(2)(D)(iii), apply, which allow these alternative increments to be exceeded on up to 18 days per year. If the federal land manager does not concur with the governor's variance, the decision goes to the president. Clean Air Act § 165(d)(2)(D)(ii), 42 U.S.C. § 7475(d)(2)(D)(ii). See also at "Legal Issues relating to PSD Baseline and Increment Consumption," North Dakota SO2 PSD Periodic Review Hearing Exhibit 2, pages 42-43, HR pages 51-52 (discussing late amendments to the 3-hour increments in the '77 CAA amendments establishing the PSD program.

[31] Id. § 7475(a)(4).

[32] 40 C.F.R. § 51.166(a)(4).

contractor, WindLogics, Inc.,[33] discovered an error in its program adopting rapid update cycle (RUC) weather data for use in the CALMET data set and CALPUFF model. After WindLogics corrected this error, the State completed its modeling in late September. This report summarizes the results of modeling conducted by the State.

In the MOU, EPA agreed that the State has discretion under the CAA and its implementing rules to choose among certain options in conducting the additional modeling. This section summarizes the options chosen and how they were applied in the modeling.

3.1 Use of CALMET and CALPUFF

Section I.1 of the MOU agreed that the State may use versions of CALMET and CALPUFF acceptable under 40 C.F.R. Part 51, Appendix W, as amended at 68 Fed. Reg. 18,440 (April 15, 2003).

In this modeling exercise, the State used CALMET and CALPUFF as agreed upon and accepted by EPA in the April 30, 2004 protocol. The CALMET user defined variables and non-IWAQM control-file inputs agreed upon by the State and EPA and used in this modeling exercise are on pages 10-12 of the April 30, 2004 modeling protocol in Addendum B. Likewise, the CALPUFF user defined variables and non-IWAQM control-file inputs that were used are on pages 14-15 of the April 30, 2004 modeling protocol in Addendum B. The State selected these user variables and established appropriate settings to adapt the model to the geophysical region and attributes of central and western North Dakota. EPA reviewed them and determined they were acceptable as part of their review of the protocol.

3.2 Normal Source Baseline Periods for Each Source

Section I.2 of the MOU agreed that when establishing the baseline emission inventory for sources existing on the minor source baseline date,[34] the State may use the "actual emissions" from "a different time period" other than "a two-year period which precedes" the minor source baseline date upon a determination that the different time period "is more representative of normal source operation."[35] EPA has long recognized in its regulations that: "If a source can demonstrate that its operation after the baseline date is more representative of normal source operation than its operation preceding the baseline date, the definition of actual emissions allows the reviewing

[33] WindLogics, Inc, is the St. Paul based company that gathered and converted the RUC data for use in CALMET.

[34] N.D. Admin. Code § 33-15-15-01(1)(e)(2) defines the "minor source baseline date," which occurred in the relevant area of North Dakota on December 19, 1977.

[35] N.D. Admin. Code § 33-15-15-01(1)(a)(1); 40 C.F.R. § 51.166(b)(21)(ii); 40 C.F.R. § 52.21(b)(21)(ii); 45 Fed. Reg. 52675, 52714 (August 7, 1980).

authority to use the more representative period to calculate the source's actual emissions contribution to the baseline concentration."[36]

In establishing the sulfur dioxide (SO2) baseline emission inventories for sources existing on the minor source baseline date, the State determined that for several sources the actual emissions from a two year time period other than the two years preceding the minor source baseline were more representative of normal source operation for those sources.[37]

There are several reasons why the State chose this option:

- Because of the 70's energy crisis, many sources were in the process of being constructed or were in stages of initial start-up on the minor source baseline date.[38]

- Electricity producing plants were constructed to produce power for current and anticipated future demand over the life of the facility, not only initial demand at the time of start-up.[39]

- Some facilities experienced initial difficulties in adapting boilers to North Dakota lignite, so normal operations were delayed for some facilities.[40]

- Net annual power generation data, known as kilowatt hours, are not available for the 1970s and early 1980s. Heat contents on the coal used to fire boilers is available for the PSD baseline period. The total annual heat content of coal burned is a reasonable alternative to determine the degree of use of respective boilers. At the PSD baseline date (1977), electricity producing plants were using between 65 and 85 percent of manufacturers' rated heat input capacity of boilers.[41]

- Three years after the minor source baseline date is a reasonable amount of time after start-up or initial construction for facilities to establish normal operations. Thus, the State determined the annual use of manufacturers' rated boiler heat input capacities for each facility from 1975 through 1980.[42]

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[36] 45 Fed. Reg. at 52,714.

[37] See Addendum "B", April 30, 2004 protocol, pages 35-39.

[38] See, e.g., Section 2.0-2.5 of "The PSD Variance Issue in North Dakota", Addendum "H".

[39] Addendum "B", April 30, 2004 protocol, page 35.

[40] See e.g., testimony by Curt Melland, "Transcript of Hearing" (June 2003), pages 178 - 184.

[41] Addendum "B", April 30, 2004 protocol, pages 35, 37 and 38. See also State Hearing Exhibit 83, "Prevention of Significant Deterioration - Sulfur Dioxide - Final Baseline Emission Rates" (May 2003), page 15.

[42] Id., at 37 - 38. See also State Hearing Exhibit 83, "Prevention of Significant Deterioration - Sulfur Dioxide - Final Baseline Emission Rates" (May 2003), pages 14 - 20.

- For the above reasons, the two consecutive years of greatest boiler capacity use between 1975 and 1980 were selected as the two years that were most representative of normal source operations.[43]

- This procedure resulted in a normal source operations determination different than the two years preceding 1977 for five of the ten sources. The two years preceding the minor source baseline date were determined to be representative of normal source operations for the other five major sources.[44]

- Production increases that were anticipated on the minor source baseline date are part of the PSD baseline emissions. "EPA thus believes that sufficient flexibility exists within the definition of actual emissions to allow any reasonably anticipated increases or decreases genuinely reflecting normal source operation to be included in the baseline concentrations."[45]

3.3 SO2 Emission Factors for Each Source

Section I.3 of the MOU agreed that the State may use emission factors based on continuous emission monitoring systems (CEMS) data to estimate baseline emissions for electric utilities if adjusted for the actual sulfur content of the coal used in the baseline period, provided they were consistent with the other data sources for the facility. The State agreed to use sulfur-content of the coal consumed during a unit's baseline normal source operations, rather than average life of mine sulfur content, in modeling conducted under this MOU.

In this modeling exercise, the State established SO2 emission factors for each source by using a mass-balanced calculation between CEMS data and corresponding coal consumption and coal-sulfur content data for each source over the period of time that the relevant reliable data was available.[46] The baseline and current emissions were adjusted for one of the units, and a representative factor was selected, for the reasons described in the protocol.[47] These factors were then used to establish baseline emission rates using baseline-period coal consumption and coal sulfur-content data. In establishing the baseline emission rate, the State used the sulfur-content of the coal used during each source's baseline period as determined by the State after determining the two year period between 1975 and 1980 that best represented each source's normal source operations as described in section 3.2 above.

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[43] Id., at 35 - 38. See also State Hearing Exhibit 83, "Prevention of Significant Deterioration - Sulfur Dioxide - Final Baseline Emission Rates" (May 2003), pages 14 - 20.

[44] Id., at 19.

[45] 45 Fed. Reg. at 52,714.

[46] Addendum "B", April 30, 2004 protocol, at pages 16-20 and 41-47.

[47] Id., at 41-46.

EPA's AP 42 guidance recognizes that if better data are available, the State, as the reviewing authority, may modify AP-42 emissions estimates, such as the AP-42 sulfur emission factor of 30.[48] This guidance also states that source specific emission tests of CEMS data are usually preferred to an estimate of source emissions.[49] Data, such as site-specific CEMS data and corresponding coal consumption and coal sulfur-content were used to establish site and unit specific emission factors for estimating baseline emissions. The State established and used the sulfur-content of the coal consumed during a unit's baseline normal source operations, rather than average life of mine sulfur content, as agreed in the MOU.

In this modeling exercise, the State developed SO2 emission factors based on the following considerations:

- The design of coal combustion systems at each facility.[50]
- Consistency among similar coal combustion systems.[51]
- Quality of data in annual reports and in EPA's CEMS data files that were provided by source operators.[52]
- Results of a field research study of SO2 emissions by some power plants during the early 1970s.[53]
- EPA's AP-42 emission factor for lignite fired boilers is an average of emissions data obtained from many plants[54] and, thus, is not uniquely specific for each coal combustion system in the state.

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[48] "Introduction to AP-42, Volume I, Fifth Edition" (January 1995), pages 1-5, at http://www.epa.gov/ttn/chief/ap42/c00s00.pdf.

[49] Id.

[50] Addendum "B", April 30, 2004 protocol, at pages 42, 46 and 47.

[51] Id., at 43 - 46.

[52] Id., at 44 and 47.

[53] Id., at 42, 43, 46 and 47.

[54] Exhibit 120, "Emission Factor Documentation for AP-42 Section 1.7, Lignite Combustion" (April 1993), table 4-1 on page 4-37, at http://www.epa.gov/ttn/chief/ap42/ch01/bgdocs/b01s07.pdf.

3.4 Use of Actual Emissions

3.4.1 Options for Actual versus Allowable Emissions

Section I.4 of the MOU agreed that consistent with the CAA and promulgated EPA and North Dakota regulations, the State may use actual emissions as defined by rule in estimation procedures for short-term time periods for all sources.

NDAC § 33-15-15-01(1)(a) defines "actual emissions" as follows:

"(a) 'Actual emissions' means the actual rate of emissions of a contaminant from an emissions unit, as determined in accordance with paragraphs 1 through 4.

"(1) In general, actual emissions as of a particular date must equal the average rate, in tons per year, at which the unit actually emitted the contaminant during a two-year period which precedes the particular date and which is representative of normal source operation. The department may allow the use of a different time period upon a determination that it is more representative of normal source operation. Actual emissions must be calculated using the unit's actual operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.

"(2) The department may presume that source-specific allowable emissions for the unit are equivalent to the actual emissions of the unit.

"(3) For any emissions unit (other than an electric utility steam generating unit specified in paragraph 4) which has not begun normal operations on the particular date, actual emissions shall equal the potential to emit of the unit on that date.

"(4) For an electric utility steam generating unit (other than a new unit or the replacement of an existing unit) actual emissions of the unit following the physical or operational change shall equal the representative actual annual emissions of the unit following the physical or operational change, provided the source owner or operator maintains and submits to the reviewing authority, on an annual basis for a period of five years from the date the unit resumes regular operation, information demonstrating that the physical or operational change did not result in an emissions increase. A longer period, not to exceed ten years, may be required by the department if it determines such a period to be more representative of normal source post change operations."

In this exercise, the State used "actual emissions" as defined by subsection (1)(a)(1) above of N.D. Admin. Code § 33-15-15-01 for the reasons discussed below.[55]

The State modeled both the actual SO2 emissions from 2000-2001 (the two most recent years of data available when the state began its PSD periodic review in 2002) and from 2002-2003 (the two

[55] This is the definition of "actual emissions" at 40 C.F.R. §§ 51.166(b)(21)(i)&(ii) and 52.21(b)(21)(i) & (ii).

most recent years for which SO2 emissions data are now available). The State modeled the 2000-2001 emissions inventory so that it could compare the results to the same two year period it modeled in its periodic review. The State also modeled the 2002-2003 emissions to determine current (2004) compliance with the SO2 increment because N.D. Admin. Code § 33-15-15-01(1)(a)(1) requires modeling of the "two-year period which precedes the particular date" except when that two year period is not "representative of normal source operation."[56]

In 1978, when EPA promulgated its first set of PSD rules after Congress enacted the PSD amendments to the CAA,[57] it adopted a definition of "allowable emissions" (rather than "actual emissions"). This definition was based primarily on "rated capacity" of the source except as reduced by restrictions on the source by the regulating entity's SIP.[58] Under this definition, EPA "plac[ed] primary emphasis on tracking emission changes rather than establishing a baseline concentration," and its regulations "no longer suggest[ed] that the baseline concentration be formally established."[59] These were the rules that were applied when North Dakota first began modeling for compliance with the PSD increment in 1978.[60]

After the Alabama Power case,[61] the 1978 PSD rules were amended in 1980 to use "actual emissions" rather than "allowable emissions" for tracking increment consumption. However, "allowable emissions" remained one of the options available to states to use as a definition for "actual emissions."[62] Another significant change between the 1978 and 1980 PSD rules was the "actual emissions" policy that provided that baseline concentration "no longer routinely includ[ed] those emissions increases after the baseline date from sources contributing to the baseline concentration."[63]

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[56] This long-established methodology is described in the example of how the definitions in the PSD rules work that was published when the rules were promulgated at 45 Fed. Reg. 52, 675, 52,704-705 (August 7, 1980).

[57] A detailed history of these amendments is attached as Addendum "G".

[58] 43 Fed. Reg. 26,380, 26,383 (June 19, 1978).

[59] Id., at 26,400.

[60] See, e.g., page 10 of "The PSD Variance Issue in North Dakota", Addendum "H".

[61] Alabama Power Co. V. Costle, 636 F.2d 323 (D.C. Cir. 1979) was a multi-party challenge to the legality of EPA's 1978 PSD rules.

[62] Preamble to 1980 rules, 45 Fed. Reg. at 52, 717. See N.D. Admin. Code § 33-15-15-01(1)(a)(2) (defining "allowable emissions" as a second way of defining "actual emissions.") The preamble to the 1980 PSD rule amendments noted that "actual emissions" could continue "to be presumed to be allowable emissions for sources subject to source-specific emissions limitations." 45 Fed. Reg. at 52,717.

[63] Preamble to 1980 PSD rules, 45 Fed. Reg. at 52, 714.

3.4.2 Gulf Coast Problem

EPA observed in 1999 that using peak short-term emission rates for all short-term periods would overestimate increment expansion because it is extremely unlikely that all sources operate at respective peak levels at the time of worst-case meteorology.[64] The State's modeling of hourly continuous emissions monitoring (CEM) sulfur dioxide emission rates paired with hourly meteorology illustrates that, in actual circumstances, the combination of peak emissions and worst-case dispersion meteorology is extremely unlikely to occur, because accuracy test results are very similar to results using actual emissions.[65]

After 1980 until 1999, when issues arose about use of "actual" emissions in modeling, North Dakota continued to presume that "allowable emissions" were a source's "actual emissions" as one of its options under its definition of "actual emissions."[66] Consequently, increment consuming sources in the State were presumed to be consuming increment at their permit allowable rates at all times, and baseline sources were presumed not to be consuming any increment provided that source emissions remained below permit allowable limits.[67]

As noted in the preamble to the 1980 rules, however, presuming "allowable emissions" equal "actual emissions" creates "the Gulf Coast problem": (1) existing sources can "increase their emissions without being subject to PSD review or the SIP revision process" provided that their emissions remain below permit allowable levels, and (2) "increment violations would be inappropriately predicted" in circumstances where actual emissions are considerably below permit allowable levels.[68] In North Dakota's draft modeling conducted in 1999, both of these conditions were present.

Measuring air quality deterioration under PSD requires establishing a "baseline concentration" on the minor source baseline date to provide the benchmark from which deterioration can be measured. The first part of the "Gulf Coast problem" – that is, that existing sources can "increase their emissions without being subject to PSD review or the SIP revision process" provided that

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[64] See Exhibit 128, Letter by Richard R. Long, US EPA, Region 8, to Dana Mount, North Dakota Department of Health (June 1, 1999).

[65] See Section 6 in Addendum "C", October 28, 2004 MOU protocol results. See also paragraphs III.C, letter of Lawrence Volmert, Exhibit 153.

[66] N.D. Admin. Code § 33-15-15-01(1)(a)(2). The practical reasons why the State had to continue to choose this option are discussed in "The PSD Variance Issue in North Dakota", Addendum "F", pages 5-15.

[67] Id.

[68] Preamble to 1980 PSD rules, 45 Fed. Reg. at 52,718. "Gulf Coast" is the name of the case where this problem first was noted. Earlier in the preamble to the '80 PSD rules, EPA had summarized "the Gulf Coast problem" as follows: "SIP shows a theoretical increment violation in a clean area, unrelated to actual air quality impact." 45 Fed. Reg. at 52,681.

their emissions remain below permit allowable levels – was addressed by the State by establishing an "actual emissions" sulfur dioxide baseline inventory for all major sources in existence in the State on the minor source baseline date.[69]

The second part of "the Gulf Coast Problem" – "increment violations would be inappropriately predicted" in circumstances where actual emissions are considerably below permit allowable levels – became an issue for the State when 1999 draft modeling (which used "allowable" emissions from increment-consuming sources) discovered a potential Gulf-Coast-like distortion of increment consumption in North Dakota. The 1999 draft modeling revealed that modeling only increment affecting sulfur dioxide emissions predicted SO2 increment consumption that was greater than the highest monitored readings in the class I areas.[70] But to make a comparison between model predictions and monitoring data, a full inventory of sulfur dioxide emissions must be modeled.

The 1999 draft modeling did not model a full inventory of PSD baseline and current inventories of "actual" occurring emissions of sulfur dioxide. Rather, increment affecting emissions were modeled after calculating emission increases after PSD baseline from existing or new sources and decreases from existing or retired sources.[71] Increment-affecting emissions of major sources, which included allowable emissions from PSD sources, represented less than half of the full inventory of increment affecting emissions (i.e., a full inventory includes both baseline and increment-affecting emissions).[72] The net emissions of new major sources dominate net increment affecting emissions, which is why use of peak emission rates, such as allowable rates under the State's 1999 draft modeling, rather than actual-occurring emissions, showed 24-hour SO2 increment consumption close to or greater than the highest monitored readings in the state's class I areas.[73] In sum, less than half of the inventory was predicting concentrations greater than the

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[69] See sections 3.2 and 3.3 above, and section 2.3 of Attachment "G," which summarizes the changes that were made when the 1980 PSD rules adopted an "actual emissions" approach to measuring air quality deterioration.

[70] The highest actual ambient 24-hr sulfur dioxide concentrations are listed in Appendix H of Addendum "B".

[71] See Appendix C and pages 19 and 20 of Addendum "B". See also tables 3a and 3b in the final of "Background Discussion of Model Input Data and Potential Refinements" which provide subtotals of sulfur dioxide emissions for the categories of baseline and current major sources shown on pages 19 and 20 of Addendum "B". Net increment affecting emissions under the MOU Protocol are 13,974.3 lb/op-hr (pounds per operating hour) for years 2000-2001.

[72] See table 4-1 of Exhibit 129, which is the Draft "Calpuff Class I Area Analysis for Milton R. Young Generating Station" dated May 24, 1999 by the Department. The draft was never finalized. The net short-term, 24-hour, increment affecting sulfur dioxide emission rates of major sources listed in the table total 4,821.4 g/s or 38,265.2 lb/hr. These rates were calculated as described in the bottom paragraph on page 7 and table 5 of Exhibit 11, which was finalized as Exhibit 133.

[73] EPA continued to use increment affecting emissions per draft reports in 2002 and 2003, and such emissions were based upon 90th percentile of hourly CEM emissions which are also peak-like rates. The point is illustrated with data in tables 3-7, 4-1 and 4-2 in EPA's "Dispersion Modeling Analysis of PSD Class I

monitored concentrations in the class I areas. This ratio suggested an over-prediction factor of 2 or higher – a clear "Gulf Coast problem."[74]

The State therefore elected to use the alternative definition of "actual emissions" as defined by subsection (1)(a)(1) of N.D. Admin. Code § 33-15-15-01 (i.e., "the average rate, in tons per year, at which the unit actually emitted the contaminant during a two-year period which precedes the particular date and which is representative of normal source operation"). To do this and make an "apples to apples" comparison, the State had to do a baseline source emissions inventory to determine the baseline SO2 concentrations in the manner provided when the rules were promulgated in 1980.[75]

In addition, the State determined that it would model a full emissions inventory (i.e., all actual "rate in tons per year" emissions from major SO2 baseline and increment consuming sources as well as oil and gas sources that continue to flare SO2 emissions within 50 kilometers of the class I areas). This allows a comparison of model-predicted concentrations with monitored SO2 concentrations to determine whether use of actual "rate in tons per year" emissions is over-predicting or under-predicting 24-hour and 3-hour SO2 increment consumption.[76]

One of the central issues in the State's 2002-2003 PSD periodic review proceeding was to examine whether switching to the actual "rate in tons per year" SO2 emissions – rather than using "allowable" SO2 emissions – adequately protected the 24-hour and 3-hour SO2 increments. Thus, an essential step of this modeling exercise – as summarized in this report and the report at Addendum "C" – is the comparison of the SO2 concentrations predicted by the modeling with the monitoring data.

Increment Consumption in North Dakota and Eastern Montana" (Exhibit 84). Specifically, the net increment affecting emission rates of major sources (table 3-7) totaled 27,250 pounds per hour for years 2000-2001; and several 24-hr estimates of highest deterioration (tables 4-1 and 4-2) exceeded highest actual ambient sulfur dioxide.

[74] The "Gulf Coast problem" was not apparent in the State when the State first modeled for compliance with the PSD SO2 increment in 1978, when the practice of flaring oil wells, and the lack of monitoring technologies, made any "accuracy assessment" impossible. But the initial FLM certifications of no adverse impact for TRNP noted this impact from flaring oil wells near the class I areas. See, e.g., page 18 of "The PSD Variance Issue in North Dakota", Addendum "H". Further, the State did not have reliable monitoring data until 1980. Id. at page 7 and 11-21, and Addendum G, section 2.3. The State completed a current inventory of sulfur dioxide emissions by minor sources (flares and treaters) that was used in 1992 and updated for year 2000 for use in 2001-2002 modeling and accuracy tests.

[75] Preamble to 1980 PSD rules, 45 Fed. Reg. at 52,714.

[76] The State calculates the emission rate in tons per year by dividing the total pounds of SO2 emitted per year by the hours of operation. Since the State then models that rate 24 hours per day 365 days per year, this methodology still models more tons of SO2 than are emitted in the State, because some sources are shut down for significant periods of time in a year, even though they are modeled as if they are running all the time.

In sum, there are several reasons why the State used "actual emissions" as defined by subsection (1)(a)(1) of N.D. Admin. Code § 33-15-15-01:

- It allowed the State to examine whether a "Gulf Coast Problem" existed when "allowable emissions" are modeled as "actual emissions".[77]

- It captures changes in utilization of rated heat input capacities of boilers, whereas use of source-specific allowable rates, as set in permits, (i.e., allowable emissions) would show no change in emissions from PSD baseline unless a capacity was modified.[78]

- It allows examination of the degree of agreement between modeled SO2 concentrations and actual SO2 observations, whereas use of source-specific allowable rates would not, and it allows an apples-to-apples expression of SO2 emission rates among all sources that contributed to PSD baseline emissions and to current emissions irrespective of the type of available data.[79]

- Actual data from the baseline period suggests that maximum short term emission rates were less than allowable emissions rates at some units during the baseline period.

In addition, using actual emissions treats all sources fairly, because actual emissions are derived from all sources equitably, using best available data.

3.4.3 Relationship of Emissions to Monitoring Data

One key factor in the State's periodic review determination was the recognition that the intent of the law was for EPA and the states to develop and utilize the most accurate and feasible modeling techniques available,[80] and "to use actual air quality data to establish the baseline" which is defined "in terms of existing ambient concentration levels" on the minor source baseline date.[81] Another key factor in the State's periodic review determination was the recognition, as recognized

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[77] See pages 19-20 above.

[78] State Hearing Exhibit 82, "An Evaluation of 'EPA Comments on North Dakota Department of Health's Proposed Determination Regarding the Adequacy of the SIP to Protect PSD Increment for Sulfur Dioxide' dated 24 May 2002" (May 2003), pages 18 - 20.

[79] Addendum "B", April 30, 2004 protocol, pages 17, 19 and 20; see also State Hearing Exhibit 82, "An Evaluation of 'EPA Comments on North Dakota Department of Health's Proposed Determination Regarding the Adequacy of the SIP to Protect PSD Increment for Sulfur Dioxide' dated 24 May 2002" (May 2003), pages 15 - 21.

[80] Conclusion 2, July 3, 2002, recommended order from hearing officer Francis J. Schwindt to State Health Officer Terry Dwelle; Alabama Power, 636 F.2d at 387.

[81] Conclusion 2, July 3, 2002, recommended order from hearing officer Francis J. Schwindt to State Health Officer Terry Dwelle; Alabama Power, 636 F.2d at 381.

in Alabama Power, that Congress intended that "monitoring would impose a certain discipline on the use of modeling techniques," through "the development of sophisticated monitoring techniques" by which modeling techniques would be "held to earth by a continual process of confirmation and reassessment, a process that enhances confidence in modeling, as a means for realistic projection of air quality."[82]

In science, "statements constituting a scientific explanation must be capable of empirical test."[83] "The criterion of the scientific status of a theory is its falsifiability, or refutability, or testability."[84]

In 1978, EPA determined that it would track increment consumption: (1) by defining and modeling only increment consuming "allowable emissions"[85] rather than a full emissions inventory of "allowable emissions" (or actual emissions); (2) by placing "primary emphasis on tracking emission changes rather than establishing a baseline concentration," and (3) by determining that it would "no longer suggest that the baseline concentration be formally established."[86] When it did so, one consequence was the generation of increment consumption estimates by computer models that could not be tested against monitored concentrations to see if the models were over-predicting or under-predicting increment consumption. In other words, the models generated predicted increment numbers that violate the basic Daubert criteria of being "capable of empirical test,"[87] and being falsifiable, refutable, or testable,[88] because the model-predicted increment consumption estimates cannot be compared to the empirical monitoring data – e.g., the SO2 monitoring data that has been gathered in North Dakota's class I areas for the past 25 years.

When EPA promulgated the post Alabama Power amendments to the PSD rules in 1980, EPA established a way to use "actual emissions" as the rate of emissions in tons per year[89] combined with a methodology for estimating total baseline and increment concentrations using both

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[82] Conclusion 3, July 3, 2002, recommended order from hearing officer Francis J. Schwindt to State Health Officer Terry Dwelle; Alabama Power, 636 F.2d at 372.

[83] Daubert v. Merrell Dow Pharmaceuticals, 509 U.S. 579, 593 (1993).

[84] Id.

[85] 43 Fed. Reg. 26,380, 26,383 (June 19, 1978).

[86] Id. at 26,400.

[87] Daubert, 509 U.S. at 593.

[88] Id.

[89] N.D. Admin. Code § 33-15-15-01(1)(a)(1); see also definition of "actual emissions" at 40 C.F.R. §§ 51.166(b)(21)(i)&(ii) and 51.21(b)(21)(i) & (ii).

monitoring and modeling.[90] In addition, EPA gave a detailed example of how to use the "rate in tons per year" definition of actual emissions and other definitions in the PSD rules when determining increment compliance.[91]

By modeling a full inventory of actual SO2 emissions in both this modeling exercise and in the modeling the State did in its 2002-2003 periodic review, the State was able to check the empirical validity of modeling results by comparing the modeled projections with the actual monitored concentrations being measured in the State's class I areas. Even the 1978 preamble – which minimized the use of monitoring data before Alabama Power noted that monitoring has an important role in PSD review[92] – recognized that if someone examines the accuracy of the modeling predictions, "EPA welcomes the submission of data which will more precisely define the impact of the source."[93]

In both this modeling exercise and in the modeling conducted in the State's 2002-2003 periodic review proceeding, the state modeled a full emissions inventory of actual emissions as defined in N.D. Admin. Code § 33-15-15-01(1)(a)(1). In both this modeling exercise and in the modeling conducted in the State's 2002-2003 periodic review proceeding, the State then compared the highest set of 24-hour predicted concentrations with the highest set of 24-hour monitored concentrations in the State's class I areas. In both instances, the comparison showed that the

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[90] See § C.8.3 "Establishing Existing Air Quality," of "Prevention of Significant Deterioration Workshop Manual (October 1980)," where EPA tells the source to begin with the "continuous" air monitoring data collected by the state, id. at p. I-C-30, determine its sufficiency, representativeness, and reliability for their proposed location, id. at p. I-C-32, and determine whether any new sources had "commenced construction or operation" in the preceding year. Id. at p. I-C-33. If these criteria are satisfied, "the monitored air quality levels" may be used "as representing existing air quality in the impact areas of the proposed source." Id. The next step is to model air quality and increment consumption, id., § C.8.5, under which "allowable emissions of all sources" may be modeled as "a conservative first attempt." Id. at p. I-C-36. "If there is a significant difference between actual and allowable emissions" of a particular source, however, "modeling can be performed using actual rather than allowable emissions." Id. at p. I-C-37.

To determine the "total projected air quality" of the proposed new or modified source or sources, the "maximum increment consumed" as determined "at [the] point of highest increment concentration in [the] impact area" is added to the "existing air quality" (as determined primarily by monitoring as described above). Id. at p. I-C-40, Table C-5. This is essentially what the FLM did in his TRNP certification by adding "modeled estimates plus monitored concentration," (i.e., increment consumption determined by modeling to monitored SO2 concentrations) to determine "predicted concentrations." 47 Fed. Reg. at 41,483.

[91] Preamble to 1980 PSD rules, "Example of How the Definitions Work," 45 Fed. Reg. 52,704 -705.

[92] Alabama Power, 636 F.2d at 372, 381, 387.

[93] Preamble to 1978 PSD rules, 43 Fed. Reg. at 26,399. The passage states in context: "Although increment consumption must of necessity be tracked through modeling, EPA does not intend that there be no 'real world' checks on the accuracy of modeling. If an applicant or other party believes that a model used by EPA has either overpredicted or underpredicted the air quality impact of a source, EPA welcomes the submission of data which will more precisely define the impact of the source."

highest 24-hour concentrations predicted by the models, including the highest second high 24-hour model predicted concentrations, exceeded highest monitored concentrations. In other words, the comparison shows – in both this modeling exercise and the State's periodic review – that the modeled-predicted highest concentrations of SO2 using the definition of actual emissions[94] did not under-predict 24-hour increment consumption in the State's class I areas. In fact the data shows, in both instances, that the use of actual emissions over-predicts short-term 24-hour and 3-hour SO2 concentrations in the State's class I areas.

3.4.4 Summary

In sum, the State chose the option of modeling "actual emissions" as defined by both federal and state rule as agreed in the MOU.[95] The State modeled a full emissions inventory of SO2 to allow a comparison of SO2 concentrations predicted by the models with the monitoring data from the State's class I areas. This modeling shows that when the "actual emissions" modeling predictions are compared with the monitoring data the results fall within accepted parameters of accuracy for the model, and this modeling methodology over-predicts rather than under-predicts SO2 24-hour concentrations in the State's class I areas.

The State retains the option under the rule to model "allowable" rather than "actual" emissions as it has in the past, as do other states.[96] Further, the issue of whether the use of "actual emissions" (as defined by N.D. Admin. Code § 33-15-15-01(1)(a)(1) (or federal rule) in modeling short-term pollutant concentrations accurately predicts short-term SO2 concentrations in a certain defined area is an empirical question that may be evaluated on a case-by-case basis. What this modeling exercise under the MOU and in its periodic review demonstrate in this instance, however, is that use of "actual emissions" data as defined by N.D. Admin. Code § 33-15-15-01(1)(a)(1) fall within acceptable model performance parameters and still over-predicts short-term increment consumption in the State's class I areas. Therefore, the use of such data adequately protects the State's Class I short term SO2 increments and lessens the apparent "Gulf Coast problem" created when the State modeled "allowable" SO2 emissions under N.D. Admin. Code § 33-15-15-01(1)(a)(2).

3.5 Use of Baseline Emission Inventory and Current Emission Inventory

Section I.5 of the MOU agreed that "[t]he State may model the baseline emission inventory and the current emissions inventory to determine estimated baseline concentrations and estimated current concentrations. This procedure may be used to determine estimated changes in contaminant concentration 'over the baseline concentration' in the ambient air, and to assist in examining the correspondence between modeling and monitoring in any accuracy analysis.

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[94] N.D. Admin. Code § 33-15-15-01(1)(a)(1); see also definition of "actual emissions" at 40 C.F.R. §§ 51.166(b)(21)(i)&(ii) and 52.21(b)(21)(i) & (ii).

[95] Id.

[96] N.D. Admin. Code § 33-15-15-01(1)(a)(2).

Alternatively, the State may model the ambient concentration change attributable to increment affecting emissions."

In this modeling exercise, the State modeled the baseline emission inventory and the current emission inventory, then tabulated predicted deterioration by pairing the model-predicted concentrations in time at each model receptor (space) for each time period (24-hour and 3-hour). This is then used as the method of determining compliance with the 24-hour or 3-hour Class I increments. The State also tabulated a high-second high 24-hour predicted concentration at each receptor for baseline and current periods for each year modeled; this is the paired-in-space-only method.

The reasons that the State chose to model a full SO2 emissions inventory are stated in section 3.4.[97] Essentially, modeling a full emissions inventory allows a comparison of computer predicted concentrations with monitoring data to evaluate the accuracy of the predictions.

In sum, the State modeled each of the two SO2 emission inventories for these reasons.

- Modeling of PSD baseline SO2 emissions allows a determination of the "baseline concentration," whereas modeling the change in the SO2 emission of each source after PSD baseline does not.[98]

- Tabulation of decrements or increments of modeled SO2 concentrations after PSD baseline by pairing modeled concentrations in time (e.g., day) as well as space (e.g., point receptor location) is more stringent than law and rule, whereas such tabulation in space only allows determination of changes in the worst case, as the second highest, from PSD baseline to current time.[99]

- Modeling of both inventories allows testing of the degree of agreement between modeled SO2 concentrations and actual SO2 observations, whereas modeling the change in the SO2 emission of each source does not.[100]

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[97] See generally N.D. Admin. Code § 33-15-15-01(2)(b); 40 C.F.R. § 51.166(c); and 40 C.F.R. § 52.21(c); 42 U.S.C. § 7473(b); 42 U.S.C. § 7479(4); 40 C.F.R. Part 51, Appendix W, § 10.1.3; and Alabama Power 636 F.2d at 372, 381, 387 (D.C. Cir. 1979), which read together show an intent by Congress that monitoring would be used to evaluate the accuracy of the model predictions. A further discussion of establishing "baseline concentration" and its history under the PSD provisions is in section 2.3 of Addendum "G".

[98] Addendum "B", April 30, 2004 protocol, page 25.

[99] Id., at 25 - 27; see also Addendum "C", "Results of air quality modeling to examine the status of attainment of PSD Class I sulfur dioxide increments" (October 28, 2004), page 26.

[100] Addendum "B", April 30, 2004 protocol, pages 25 - 26.

3.6 Use of Mesoscale Meteorological Data

Section I.6 of the MOU agreed that: "The State may model five years of representative mesoscale meteorological data, such as National Weather Service (NWS) upper air/hourly surface data. Alternatively, the State may model three years of mesoscale meteorological data suitable for CALMET, such as advanced MM5 or Rapid Update Cycle [RUC] data, as input for the CALPUFF air quality modeling in conjunction with appropriate standard NWS [data] or comparable meteorological observations within or near the modeling domain. Processing of prognostic meteorological data sets must be made available to EPA."

In this modeling exercise, the State modeled RUC weather data for the years 2000, 2001 and 2002, in conjunction with NWS weather data as input weather data for its CALMET and CALPUFF modeling of SO2 concentrations in class I areas for the years of 2000, 2001, and 2002.

EPA guidance allows use of three years of prognostic meteorological data, such as advanced MM5 or RUC data as input data for the CALMET meteorological model "if mesoscale meteorological fields are available" and appropriately implemented into the model.[101] Such use is consistent with the intent of the CAA to develop and utilize the most accurate and feasible modeling techniques available.[102]

The following were some of the steps taken in implementing RUC data for this modeling exercise:

- The RUC data sets are produced with the prognostic (predictive) weather model known as the Rapid Update Cycle model that was developed by NOAA's Forecast Simulation Laboratory. This model predicts weather data, such as winds, at multiple elevations above ground level and on high-resolution grids, such as 40 kilometers.[103]

- A report completed for EPA in 2003 indicates that the "RUC operational data is by far the most complete dataset available in lieu of running a mesoscale [prognostic meteorological] model." The use of the RUC data sets "could significantly improve model performance over using coarser resolution data sets . . ."[104]

- The space and time resolution of the RUC data sets is superior to the surface weather observations and twice daily upper air rawinsonde observations obtained and archived by the National Weather Service.

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[101] 40 C.F.R. Part 51, Appendix W, § 9.3.1.2(d) and § 9.3(c).

[102] Conclusion 2, July 3, 2003, recommended order from hearing officer Francis J. Schwindt to State Health Officer Terry Dwelle; Alabama Power, 636 F.2d at 387.

[103] Addendum "D", "RUC Analysis-based CALMET Meteorological Data for the State of North Dakota" (August 2004), pages 1 - 5.

[104] "Alternative Meteorological Datasets for North America" (February 2003), pages 8 and 9. By ATMET, LLC, for USEPA, attachment 1 to Addendum "B".

3.7 Recognition of the State's FLM Certifications

Section II.1 of the MOU noted that the State and EPA have not reached agreement concerning "[w]hether to include emissions of sources granted Federal Land Manager [FLM] variances under CAA § 165 when determining consumption of the PSD Class I sulfur dioxide [SO2] increment," but agreed that the State and EPA "will continue to evaluate these issues and to engage in a technical dialogue to resolve them.

Between 1982 and 1993, several new facilities were permitted in North Dakota for construction based on federal land managers determinations under 42 U.S.C. § 7475(d) that they would have no adverse impacts on air quality related values.[105] Two North Dakota facilities continue to operate under these FLM certifications of no adverse impact. 42 U.S.C. § 7475(d)(2)(C)(iii & iv); 47 Fed. Reg. 41,480 (Little Knife); 58 Fed. Reg. 13,639 (currently Dakota Gasification Company).

On July 6, 2004, the State forwarded to EPA a draft analysis of the FLM certification/variance issue with attachments. An updated final of this analysis is attached and included in Addendum "H."

As agreed, this exercise models a full SO2 emissions inventory. In one technical analysis of predicted concentrations, the FLM CAA § 165 variance sources are counted as consuming increment against the CAA § 163(b)(1) SO2 increment instead of the alternative CAA § 165(d)(2)(C)(iv). In another technical analysis, the two relevant sources are not counted as consuming SO2 increment under CAA § 163(b)(1).

Based on this analysis and technical review, the State's position remains that the most reasonable construction of the PSD statutes, legislative history, and history of application in the North Dakota FLM certification proceedings discussed in section 2.4.2 of the attached report (Addendum "H"), is that SO2 emissions from Little Knife and DGC consume increment against the alternative Class I increment under CAA § 165(d)(2)(C)(iv), 42 U.S.C.A. § 7475(d)(2)(C)(iv) and N.D. Admin. Code § 33-15-15-01(4)(j)(4)(b), but not against the Class I increment under CAA § 163(b)(1), 42 U.S.C.A. § 7473(b)(1).

3.8 Methods of Calculating Air Quality Deterioration

Section II.2 of the MOU noted that the State and EPA have not reached agreement concerning "[w]hether the specific method of calculating air quality deterioration and PSD increment consumption from model outputs as used by the State [in its 2002-2003 periodic review, i.e., the methodology that calculates a baseline concentration also referred to as the paired-in-space-only methodology] is consistent with the CAA and promulgated EPA regulations."

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[105] See 47 Fed. Reg. 30,222 (1982), and 58 Fed. Reg. 13,639 (1993) and "PSD Variance Issue in North Dakota," Sections 2.0-2.5,, attached to this Report as Addendum "H" for a more detailed summary.

As agreed to in the MOU, this modeling exercise calculated deterioration using predicted concentrations paired in time at each modeled receptor (space) (often referred to as the paired-in-space-and-time method) to determine compliance with the 3-hour and 24-hour increments. In addition, this modeling exercise also conducted a paired-in-space-only analysis of predicted concentrations.

Under the paired-in-space-and-time method, modeling of increment affecting emissions with current meteorology results in estimates of deterioration that are paired at each receptor for each 3-hour and 24-hour time period.[106] In contrast, the foundation for using the paired-in-space-only methodology is determining short-term (3-hour and 24-hour) baseline concentrations[107] due to PSD baseline emissions.[108] When applying the paired-in-space-only method to estimate deterioration, 3-hour or 24-hour baseline concentrations are subtracted, respectively, from each sequential 3-hour or 24-hour (daily) concentration obtained from modeling the current inventory of emissions.

The methods of calculating estimated deterioration (1) from modeled changes in concentrations using increment-affecting emissions (paired-in-space-and-time) and (2) from modeled baseline and current inventories of emissions (paired-in-space-only) are described in the Addendum "B" and in Addendum "C". The results of these calculations are summarized in Addendum "C" and section 4.0 below.

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[106] Increment-affecting sulfur dioxide emissions were modeled by the State in 1999 (Exhibit 129) and by EPA in 2003 (Exhibit 84).

[107] N.D. Admin. Code § 33-15-15-01(1)(d)(1) defines "Baseline Concentration" as "that ambient concentration level that exists in the baseline area at the time of the applicable minor source baseline date." CAA § 169(4), 42 U.S.C. § 7479(4), defines "baseline concentration as follows:

> "The term 'baseline concentration' means, with respect to a pollutant, the ambient concentration levels which exist at the time of the first application for a permit in an area subject to this part, based on air quality data available in the Environmental Protection Agency or a State air pollution control agency and on such monitoring data as the permit applicant is required to submit."

[108] Addendum "B", April 30, 2004 protocol, pages 25 - 28; and also Addendum "C", October 28, 2004, protocol results, pages 26 - 28 and also State Hearing Exhibit 82, "An Evaluation of 'EPA Comments on North Dakota Department of Health's Proposed Determination Regarding the Adequacy of the SIP to Protect PSD Increment for Sulfur Dioxide' dated 24 May 2002" (May 2003), pages 21 - 24.

4.0 Summary of Modeling Results[109]

The State of North Dakota prepared an Alternate Modeling Protocol (Addendum "B") pursuant to a State and U.S. Environmental Protection Agency Memorandum of Understanding (MOU) (Addendum "A"). EPA verbally approved this protocol on April 28, 2004. The protocol addresses all issues and suggestions raised by EPA during negotiation of the MOU and review of drafts of the protocol. It also describes the data inputs for the CALMET and CALPUFF models, sulfur dioxide emission inventories such as source emission rates, locations and stack characteristics, the background concentration for accuracy tests, and the math methods for calculation of sulfur dioxide deterioration.

The Department did not deviate from the MOU Alternate Modeling Protocol in executing the modeling described in this summary and in Addendum "C," the Protocol Results Report. The Department did model additional years of emissions data, in addition to the 2000-2001 emissions data described in the protocol, following all other details of the protocol as described below.

The modeling Protocol Results Report (Addendum "C") discusses the execution of the April 30, 2004 protocol and supporting reasons for the choices the State made in execution of the protocol.[110] The report also contains the modeled results of the execution of the protocol, and the accuracy assessment conducted for 2002 when an accuracy issue was raised relating to the 2002 results.

The modeling results report also includes an assessment of whether the Class I sulfur dioxide increments are being violated at the lower sulfur dioxide emission rates that occurred in North Dakota in 2002-2003 for the year 2002, the year for which a violation of the Class I increments was predicted at 2000-2001 emission rates. Tables of data demonstrating attainment of the PSD 3-hour and 24-hour sulfur dioxide increments when using 2002-2003 actual emission and 2002 RUC data are provided in Appendix I of Addendum "C." These data are also included in tables 8 – 13 of Addendum "C." Additional tables of data when using 2002-2003 actual emissions with 2000 and 2001 RUC data are provided in Exhibit 134. The data in these tables also show compliance with the 3-hour and 24-hour sulfur dioxide increments when using 2002-2003 actual emissions.

Each modeling run (i.e., the modeling run at 2000-2001 sulfur dioxide emission rates and the modeling run for 2002-2003 sulfur dioxide emission rates) includes an assessment of Class I sulfur dioxide increment consumption using the paired-in-time-and-space methodology and also

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[109] Section 4.0 of the draft final of this report contained a shorter summary of the modeling results. It then referred to Addendum "C", the Protocol Results Report, for a detailed discussion of the results and the reasons and rationale for steps taken. Section 1.2 of Addendum "C" summarizes the conclusions reached upon completion of the modeling. The hearing officer felt it would be helpful to expand upon section 1.2 in this final report to provide a more complete explanation of modeling results. This expanded section also includes additions based upon oral and written comments received by the Department.

[110] See also Exhibit 117, "Background Discussion of Model Input Data and Potential Refinements", and Addendum I.

the paired-in-space only methodology. See section 3.8 above. Each modeling run also includes an assessment of Class I sulfur dioxide increment consumption both when the two sources that have been granted FLM variances under CAA § 165(d)(2)(C)(i)[111] are counted as increment consuming sources against the Class I sulfur dioxide increment at CAA § 163(b)(1),[112] and also when the two sources that have been granted FLM variances under CAA § 165(d)(2)(C)(i)[113] are counted as increment consuming sources only against the alternative Class I sulfur dioxide increment that applies to FLM variance sources at CAA § 165(d)(2)(C)(iv).[114]

The results from the execution of the protocol at 2000-2001 sulfur dioxide emission rates indicate:

1) No exceedances of the 3-hour PSD Class I increment in any PSD Class I area;[115]

2) No exceedances of the 24-hour Class I increment at any one receptor in Class I areas when using 2000 and 2001 meteorological data;

3) No exceedances of the 24-hour increment at any one receptor in the Elkhorn Ranch Unit of the Theodore Roosevelt National Park (TRNP), Lostwood Wilderness Area and Montana class I areas when using 2002 meteorological data; and

4) One or two exceedances of the 24-hour increment at some receptors in the South and North Units of the TRNP when using 2002 meteorological data. No receptor had more than two exceedances.[116]

One of the reasons the State agreed to model 2000-2001 sulfur dioxide emissions in the protocol[117] was to compare the results with the modeling results from its 2002-2003 periodic review. When one or two exceedances of the 24-hour increment at some receptors in the South and North Units of the TRNP occurred when using 2002 meteorological data and 2000-2001 actual emissions,[118] the next obvious step was to do the accuracy assessment test for 2002 described above. And when

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[111] 42 U.S.C. § 7475(d)(2)(C)(i).

[112] 42 U.S.C. § 7473(b)(1).

[113] 42 U.S.C. § 7475(d)(2)(C)(i).

[114] 42 U.S.C. § 7475(d)(2)(C)(iv).

[115] Addendum "C" (hereafter referred to as "Protocol Results Report"), § 8.1.

[116] Protocol Results Report §§ 8.1 and 9.3.

[117] Addendum "B".

[118] Protocol Results Report §§ 8.1 and 9.3.

the 2003 emissions data became available in June 2004,[119] the Department then modeled the two most recent years of emissions data as required by rule[120] to determine whether the increment was being exceeded.

The CALMET/CALPUFF results for year 2002 RUC data using 2000-2001 actual emissions were unexpected. The accuracy ratios for 2002 were larger than the ratios for 2000 and 2001 (meaning there was poorer agreement between model-estimated concentrations and monitoring data for 2002 than for 2000 and 2001) when using the 2000-2001 actual emissions and the respective RUC meteorology for 2000, 2001, and 2002. Because year 2002 emission rates were less than the 2000-2001 actual emissions, the State proceeded to test the accuracy of the modeling using only 2002 emissions with 2002 RUC data to see if the accuracy ratio for 2002 would improve when 2002 emission rates were used instead of 2000-2001 actual emissions.

The results of accuracy tests, when comparing the 25 largest predicted sulfur dioxide concentrations to the 25 largest observed concentrations, indicate that:

- Model accuracy is acceptable when using 2000-2001 actual emissions with 2000 and 2001 meteorological data.[121]

- Some 24-hour predicted concentrations contain a bias greater than the 24-hour increment when using 2000-2001 actual emissions with 2002 meteorological data.[122]

- Over prediction bias in predicted concentrations decreases about 20 percent when 2000-2001 actual emissions are replaced with 2002 emission rates and when using 2002 meteorological data.[123]

- Model accuracy does not change appreciably when replacing 2000-2001 actual emissions and 2002 emissions with year-by-year hourly CEM emissions that are paired year-to-year with hourly meteorology.[124]

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[119] The full set CEM emissions data for the previous year generally is accessible on EPA's Acid Rain Program web-site data system during the second quarter of the following year. The usual lag time is four to five months.

[120] See Exhibit 84, p. 25, and the definition of "actual emissions" in the PSD rules. See § 3.4.1 of this report above, where the definition is quoted in its entirety..

[121] Protocol Results Report §§ 5.2 & 5.3.

[122] Protocol Results Report §§ 5.2, 5.3, & 10.1

[123] Protocol Results Report §§ 5.2 & 5.3.

[124] Protocol Results Report §§ 6.1 & 6.2.

Averaged accuracy ratios[125] obtained from the accuracy tests range from values near 1.0 to a value larger than 2.0. EPA has often cited factors of one-half (0.5) to two (2.0) as an acceptable range for accuracy ratios.[126]

- When over prediction bias is larger than 40 percent (accuracy ratios larger than 1.4), the amount of over prediction for 24-hour deterioration can exceed 5 ug/m3, which is the PSD Class I sulfur dioxide 24-hour increment.[127]

- The factor of two is not a bright line between acceptable and unacceptable model accuracy. There are no guiding principles for acceptable or unacceptable model accuracy performance.[128]

- Model accuracy test results depend on numerous model data inputs, but all year-to-year inputs provided by the protocol remain unchanged except meteorological data and hourly CEM emissions data. Day-to-day and year-to-year variation in regional weather has a profound effect on predicted concentrations and, thus, accuracy ratios.[129]

These accuracy test results demonstrate that using peak-like sulfur dioxide emission rates, such are permit allowable rates or 90th percentile rates, would increase over-prediction of monitored concentrations because peak-like rates are larger that actual emissions and, thus, would cause Gulf-Coast-like distortion of model estimated increment consumption.[130]

In 2003, EPA stated that "[e]missions for the current year inventory are based on actual emissions reflected by normal source operation for a period of two years. *The two-year study period should generally be the most recent two years*, provided that the two-year period is representative of normal source operation."[131] (Italics added.) Additional emissions data for year 2003 became available while the MOU modeling was in progress, making assembly and modeling of 2002-2003 actual emissions possible.

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[125] Protocol Results Report §§ 5.2 , 6.2, & 6.3.

[126] See 40 CFR Part 51, Appendix W, § 10.

[127] Protocol Results Report § 10.1.

[128] Protocol Results Report § 6.4.

[129] Protocol Results Report §§ 5.2, 5.3, 6.2, 6.3 & Appendix E.

[130] See Exhibit 33 and Appendix B of Addendum "B".

[131] See Exhibit 84, p. 25. This echoes the definition of "actual emissions" in the PSD rules. See § 3.4.1 of this report above, where the definition is quoted in its entirety.

When 2000-2001 actual emissions are replaced with 2002-2003 actual emissions and the protocol is followed using that emissions inventory, computed changes in 3-hour and 24-hour predicted sulfur dioxide concentrations reveal:

- No exceedances of the PSD Class I 3-hour increment (25 ug/m3) during 2002.[132]

- No exceedances of the PSD Class I 24-hour increment (5 ug/m3) during 2002.[133]

Replacing the 2000-2001 actual emissions of the protocol with 2002-2003 actual emissions when using 2002 meteorological data is appropriate because:

- NDAC § 33-15-15-01(1)(a)(1) requires two most recent years of data to show increment compliance.[134]

- The averaged accuracy test ratios using 2000-2001 emissions with 2002 meteorological data are unacceptable.[135] The ratios from an accuracy test using 2002 emissions with 2002 meteorological data improved significantly.[136]

- The 2002-2003 actual emissions are similar to 2002 emissions.[137]

- The most recent emissions data, in this case 2002-2003 actual emissions, are needed for any current assessment of sulfur dioxide deterioration.[138]

In sum, no exceedences of the 3-hour or 24-hour Class I sulfur dioxide increments occur under any modeling option executed using 2002-2003 sulfur dioxide emissions.

An additional interesting result of the modeling was the high-second-high increment consumption (ug/m3) calculated by the paired-in-space method. This paired-in-space increment consumption

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[132] Protocol Results Report § 8.1.

[133] Protocol Results Report § 8.1. See also additional tables of data which show modeling results when using 2002-2003 actual emissions with 2000 and 2001 RUC data in Exhibit 134. The data in these tables also show compliance with the 3-hour and 24-hour sulfur dioxide increments when using 2002-2003 actual emissions for years 2000 and 2001.

[134] ND's SO2 PSD Air Quality Modeling Report § 3.4.

[135] Protocol Results Report §§ 5.2 & 5.3.

[136] Protocol Results Report §§ 6.1, 6.2, & 6.4.

[137] Protocol Results Report § 6.1.

[138] ND's SO2 PSD Air Quality Modeling Report §§ 3.4 & 4.0.

was larger than the high-second-high increment consumption by the paired-in-space-and-time method.[139]

This interesting result appears to be related to the versions of CALMET the Department used under the protocol. The Department used older versions of CALMET and CALPUFF as verbally agreed to by EPA on April 28th 2004, rather than newer versions referenced in EPA's upgrading of Appendix W in 2003.[140] At page 3-1 in Exhibit 153, ENSR provides a possible explanation for the unexpected paired-in-space-only results for 2002:

> "In the older CALPUFF, the selection of certain variables, such as solar angle, atmospheric density, the heat flux, and relative humidity are done by selecting these data from the nearest airport station. In the updated version, these variables are interpolated between stations at each grid point. This is especially important in areas with sparse data coverage, and results in more representative depictions of these variables at each model grid point. The effect upon modeling results is difficult to predict because th effect of these variables on atmospheric stability, mixing height, and other variables that could affect plume trajectories is case-specific. There are also various error fixes that may results [sic] in minor changes to the prediction results."

It appears that the use of the most recent versions of CALMET and CALPUFF will resolve the technical issues which were causing high-second-high paired-in-space to be higher than high-second-high paired-in-space-and-time. The State has used monitoring data to check model accuracy,[141] and used the best available models, meteorological data, monitoring data, and emissions data, as those models and data become available, after considering performance through model accuracy performance testing.[142] Thus, consistent with the State's policy, the State should adopt and use the most recent versions of CALMET and CALPUFF in future PSD modeling.

In summary, the Department implemented the six issues of discretion described in Section I of the MOU in its modeling and report to EPA. This modeling is presented in the Protocol Results Report and demonstrates attainment of the PSD Class I 3-hour and 24-hour increments at 2002-2003 sulfur dioxide emission levels using both the paired-in-time-and-space and paired-in-space

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[139] See §§ 9 and 10.4 of the Protocol Results Report and § 7.1 of Exhibit 117 (also Addendum I).

[140] See Exhibit 132 and 68 Fed. Reg. 18,440, 18,475 (April 15, 2003) (referring to upgraded versions of CALMET and CALPUFF available at Earth Tech's website at http://www.src.com/calpuff/calpuff1.htm.)

[141] See Protocol Results Report, § 9 and Alabama Power Co. v. Costle, 636 F.2d 323, 372 (D.C. Cir. 1979).

[142] Id.

methods.[143] This occurs without under-prediction of actual sulfur dioxide in the ambient air as demonstrated by model accuracy tests.[144]

[143] Protocol Results Report § 8.1. See also additional tables of data which show modeling results when using 2002-2003 actual emissions with 2000 and 2001 RUC data in Exhibit 134. The data in these tables also show compliance with the 3-hour and 24-hour sulfur dioxide increments when using 2002-2003 actual emissions for years 2000 and 2001.

[144] See footnotes 116-130 and accompanying text above.